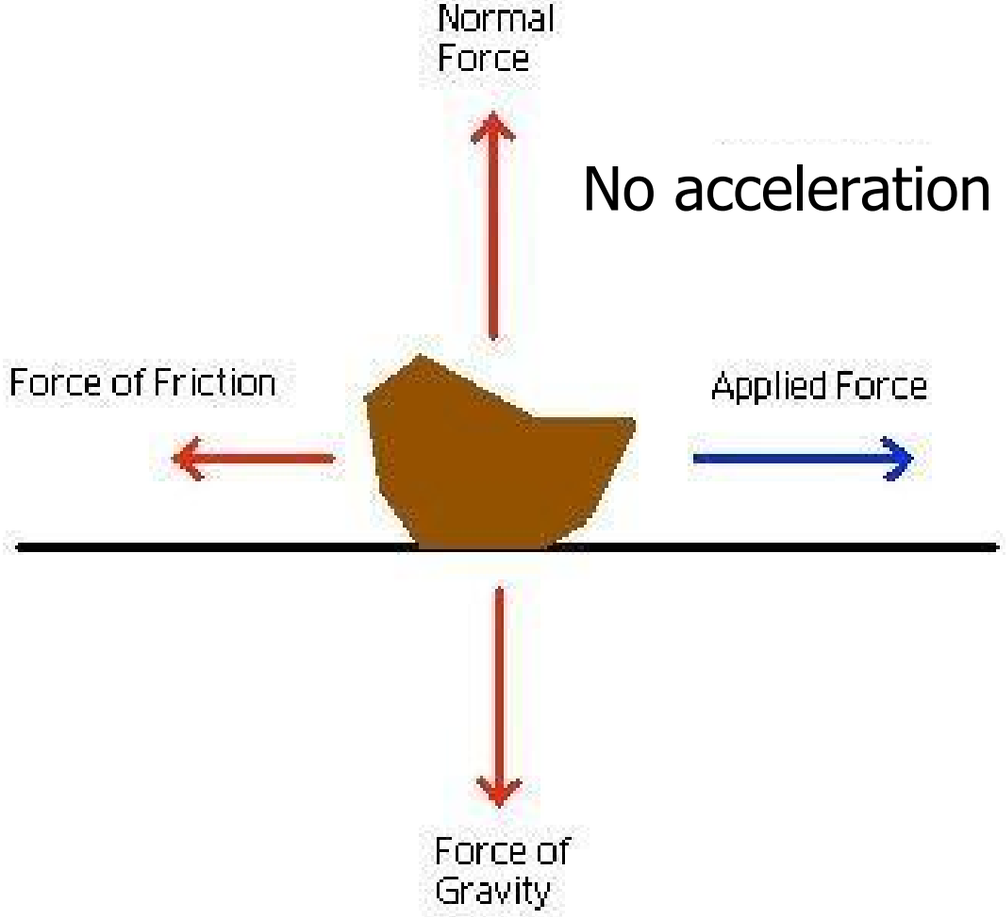
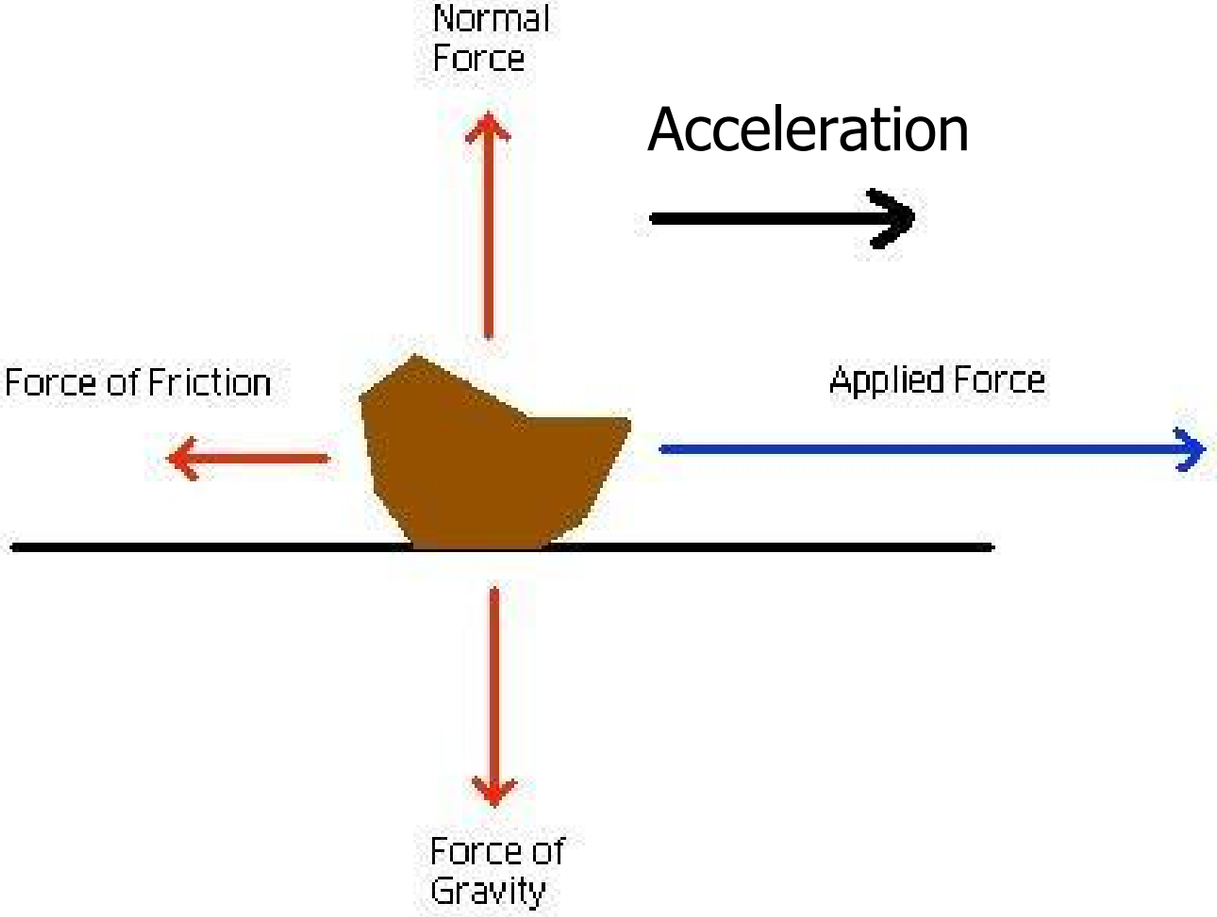
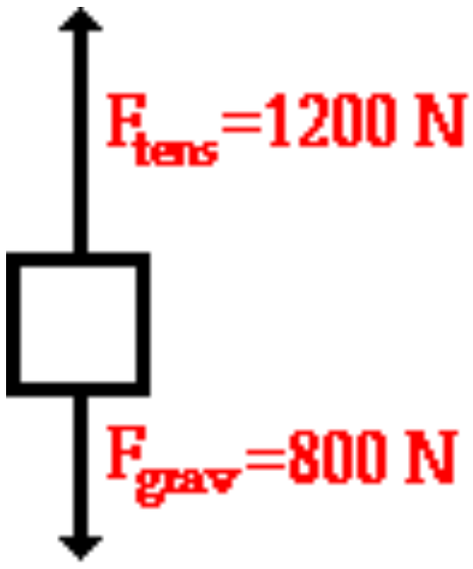
Forces & Motion

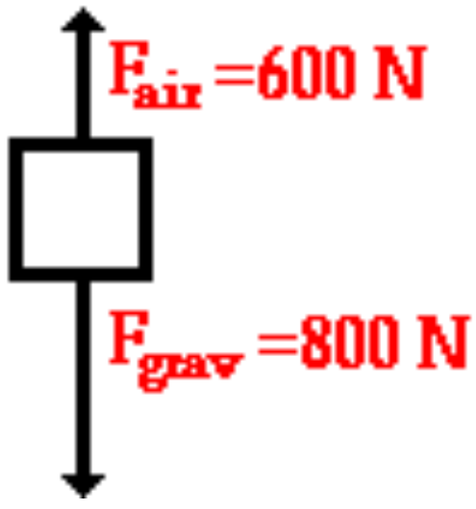
Physical Science

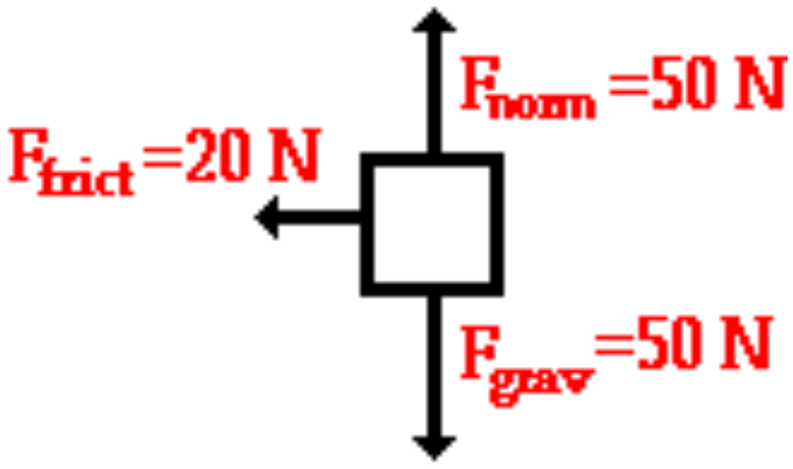
- **Force- push or pull that one object exerts on another**
  - **Examples: hitting a baseball, throwing a basketball, etc.**
  - **Forces aren't always noticeable**
    - **Floor pushes up on you- otherwise you'd fall**
  - **Forces influence motion**
    - **Changes the velocity- either the speed or direction**






F_{tens}=1200 N
F_{grav}=800 N


F_{air} =600 N
F_{grav} =800 N


F_{norm} =50 N
F_{frict} =20 N
F_{grav} =50 N

The forces on the person are balanced.

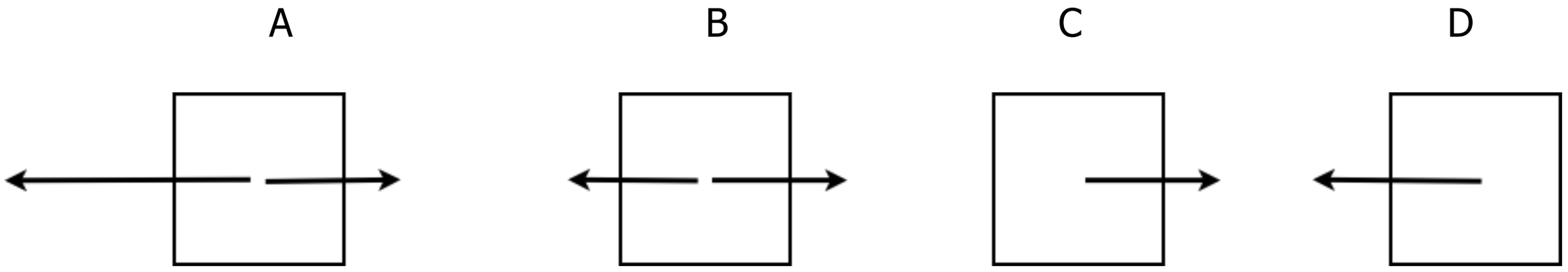
II. Inertia- an object's resistance to a change in motion

A. If moving; stays moving

B. If stopped; stays stopped

III. Newton's 1st Law: Objects will stay in constant motion, or at rest, unless acted on by a NET force.

A. Known as the law of inertia



Which diagram above shows a force diagram for a car traveling at a constant velocity to the right.

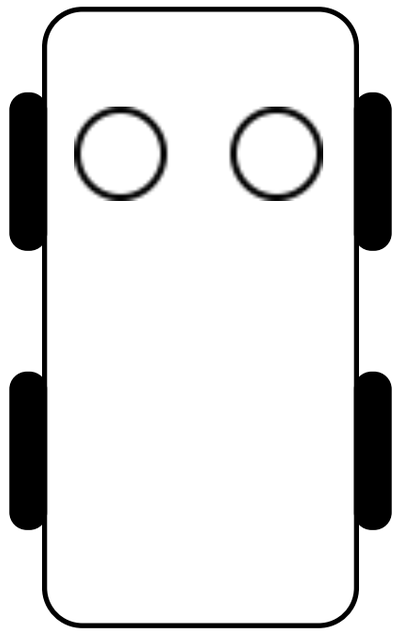
What device was added to cars to help protect passengers for when a car takes off at a green light?

A. Head Rest

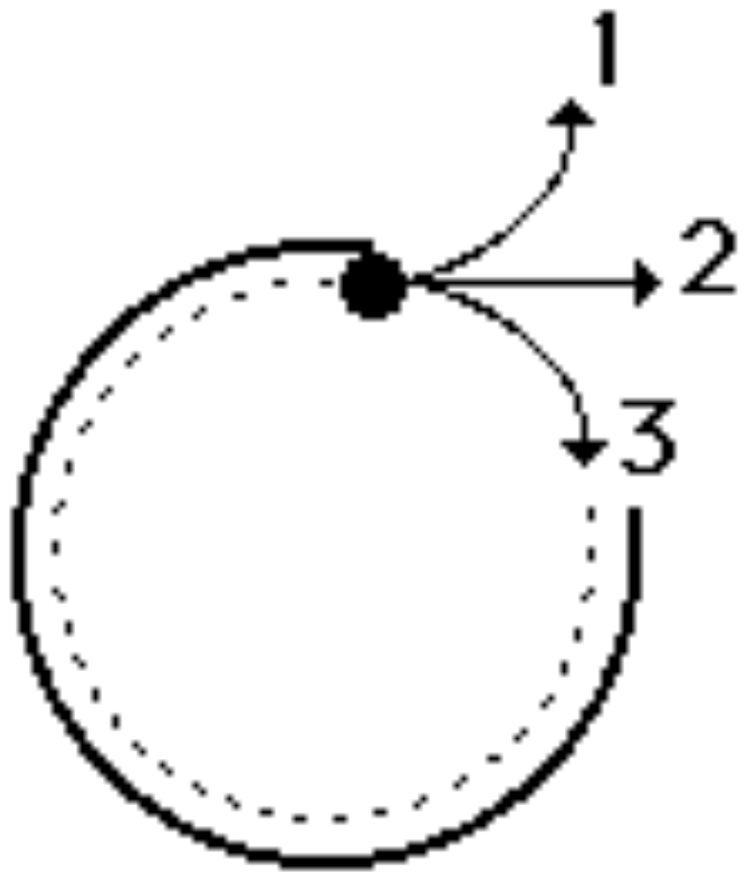
B. Air Bag

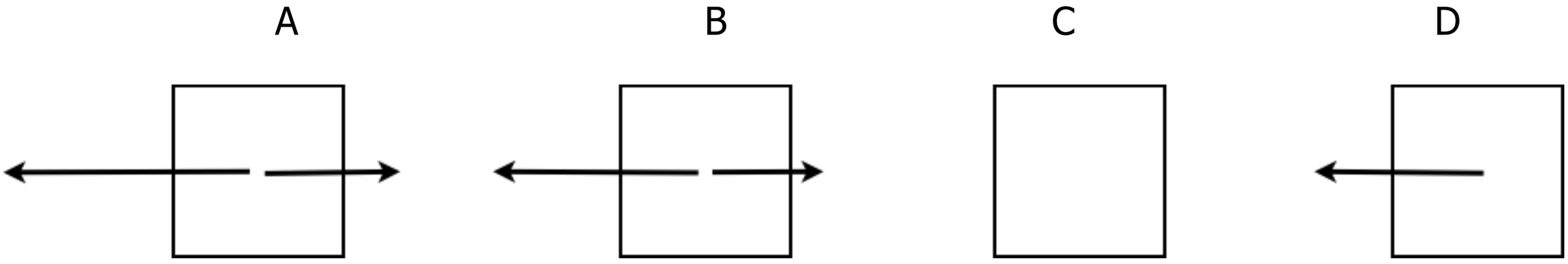
C. Seat Belt

D. Steering Wheel



In which direction will a ball travel after moving around a circular path





If a spaceship fired a cannonball into frictionless space, what diagram above shows the forces needed for the ball to remain in constant motion? (The ball is moving to the left)

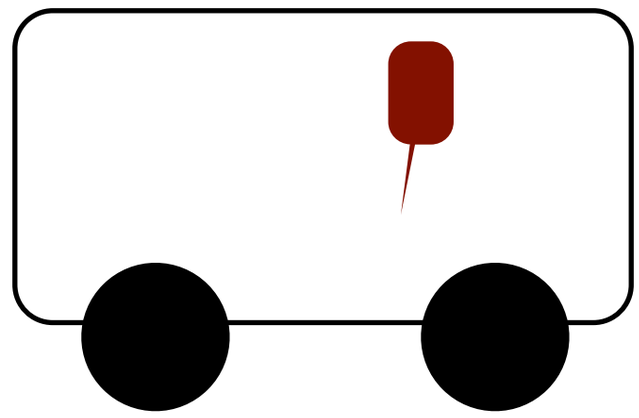
You observe a parked car with a helium balloon floating inside. When the car backs out of the parking space what is the resulting motion of the balloon?

A. Moves back with the car

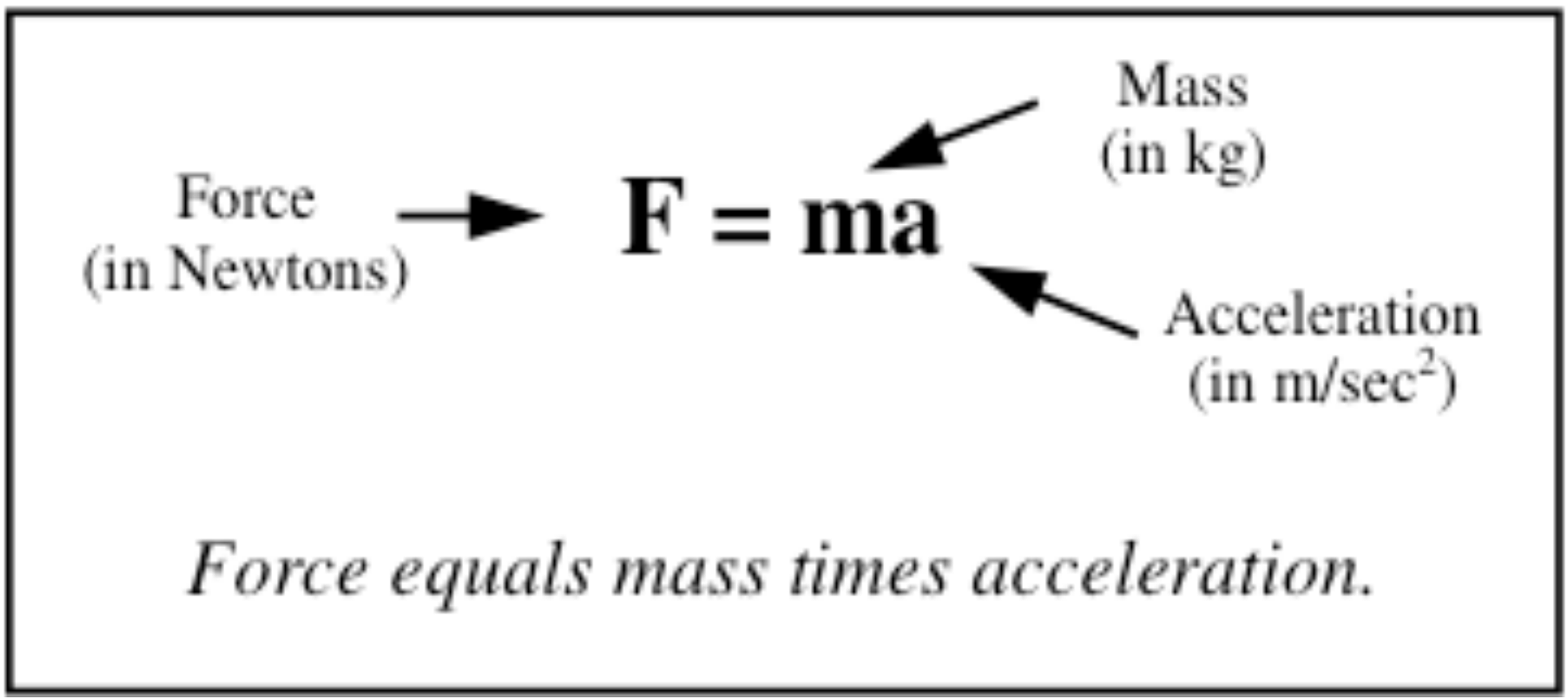
B. Does not move

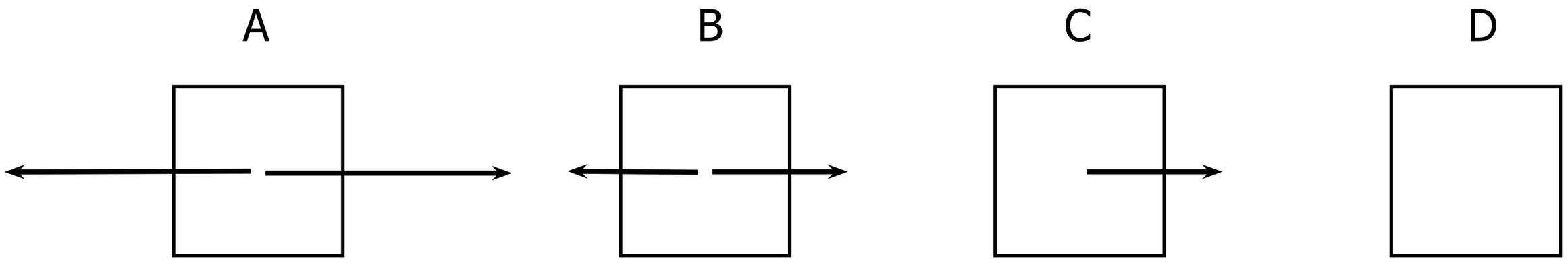
C. Moves forward

D. Floats upwards



Newton's 2nd Law: Objects will accelerate when acted on by a NET force.





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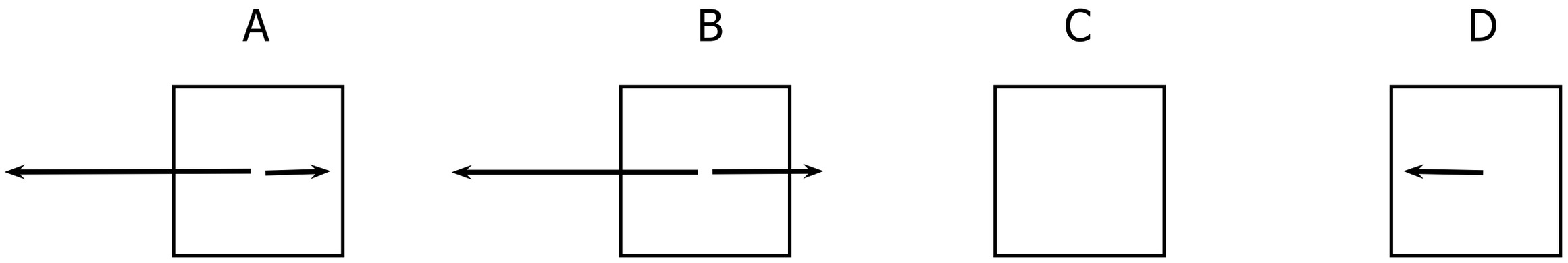


Which object is moving to the left and is speeding up the most?

If a 50 N force pulls on a 10 kg object, what will the acceleration of the object be?

A 49 N force pulls on an object and creates an acceleration of 7 m/s^2. What is the object's mass?

A boat moves through the water with two forces acting on it. One is a 2,100 N forward push by the motor, and the other is a 1,800 N resistive force due to the water.

What is the net force acting on the boat?

What is the acceleration of the 1200 kg boat?

Both a bus and a sports car are stopped at a red light. When the light turns green, both vehicles accelerate at the same rate. After the first 200 m, which car is in front?

Which car has a greater net force acting on it?

Gravity

V. Gravity on Earth produces a constant acceleration on everything

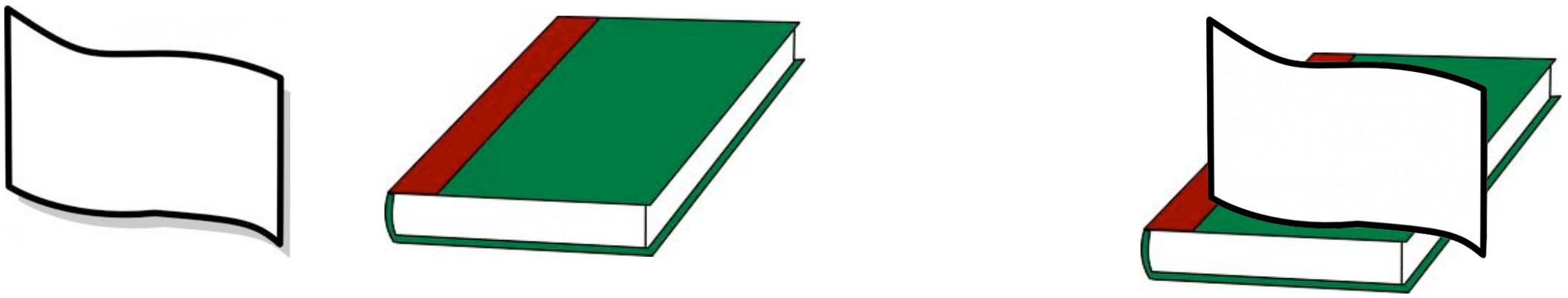
A. It is measured to be 9.8 m/s^2 or 10 m/s^2

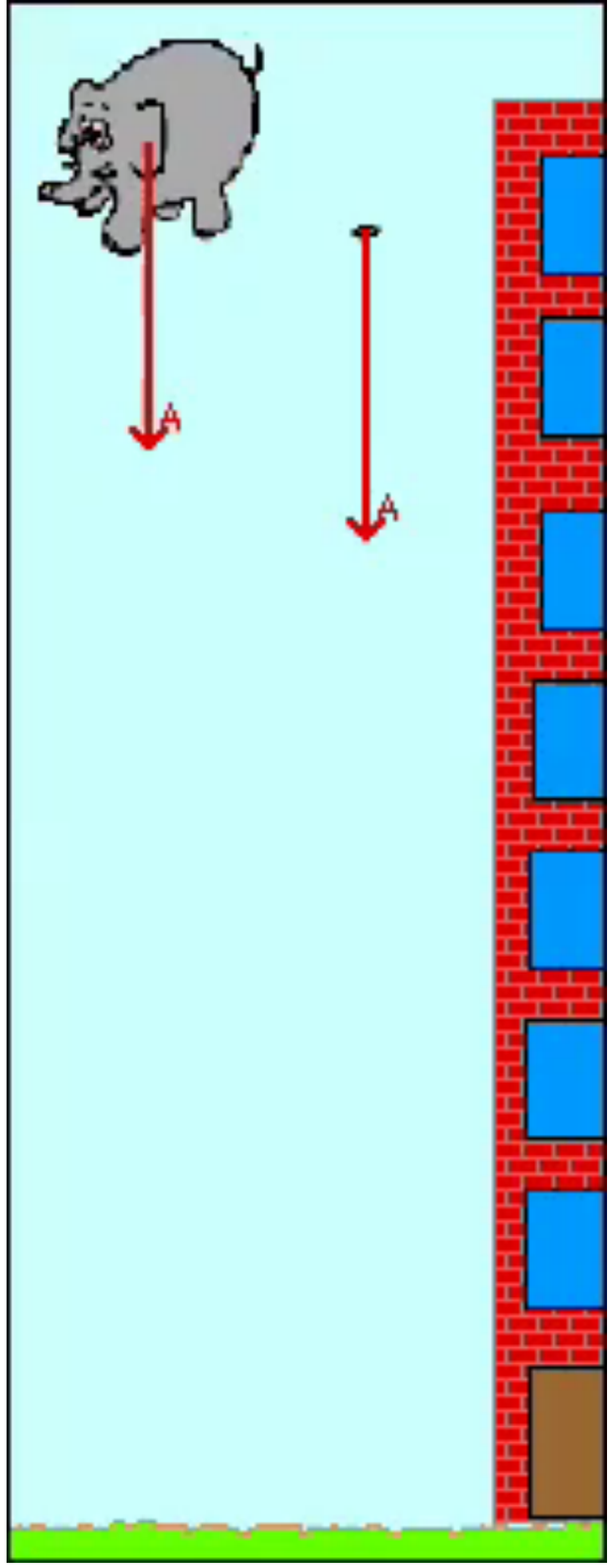
B. This means that everything should fall at the same rate of acceleration

C. The bigger an object's mass, the greater the gravitational force

$$a_g = \frac{F_g}{m} \qquad a_g = \frac{20N}{2kg} \qquad a_g = \frac{10N}{1kg}$$

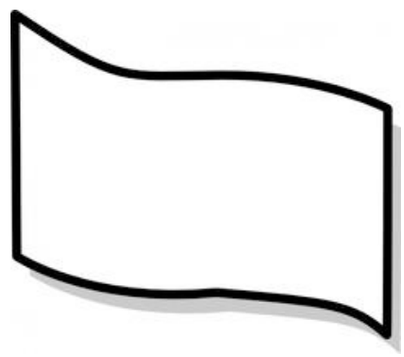
- What hits first?

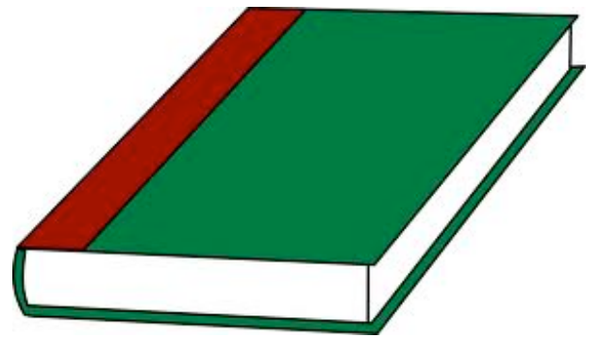




B. <u>Air resistance</u>- the force that opposes motion

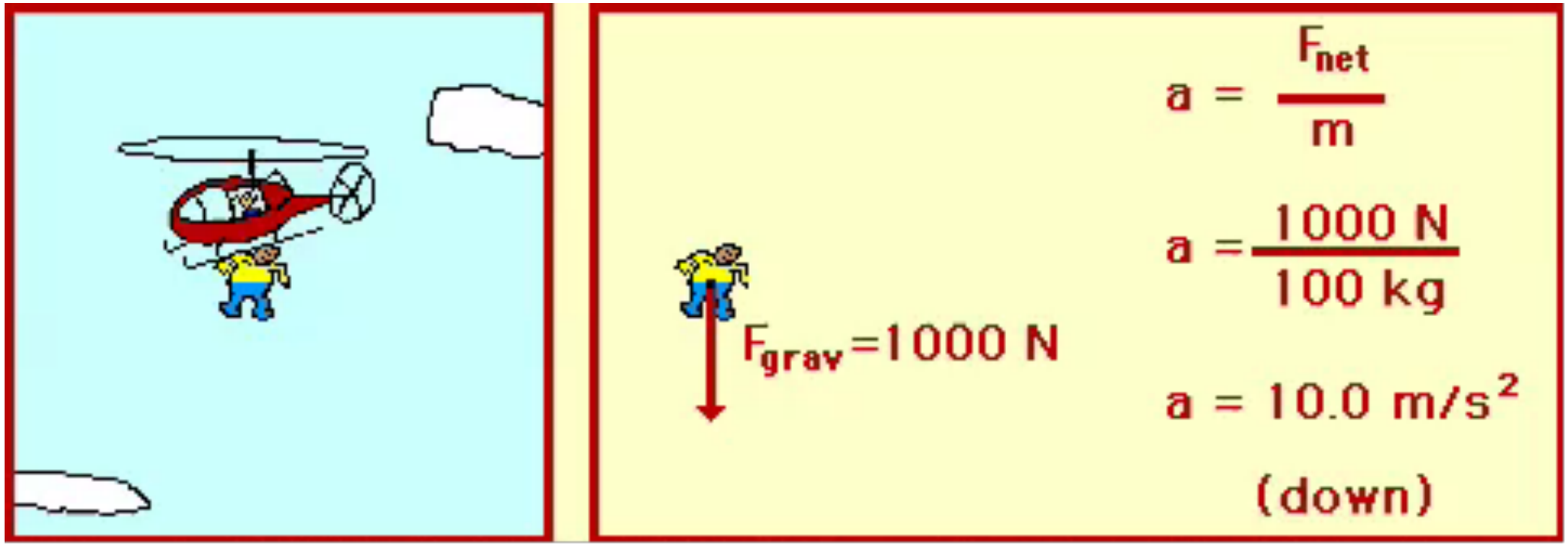
1. depends on an object's shape, size, and speed





Newton's Second Law

2. <u>Terminal velocity-</u> forces on a falling object are balanced and the object falls with constant speed (for humans is 120 mph)



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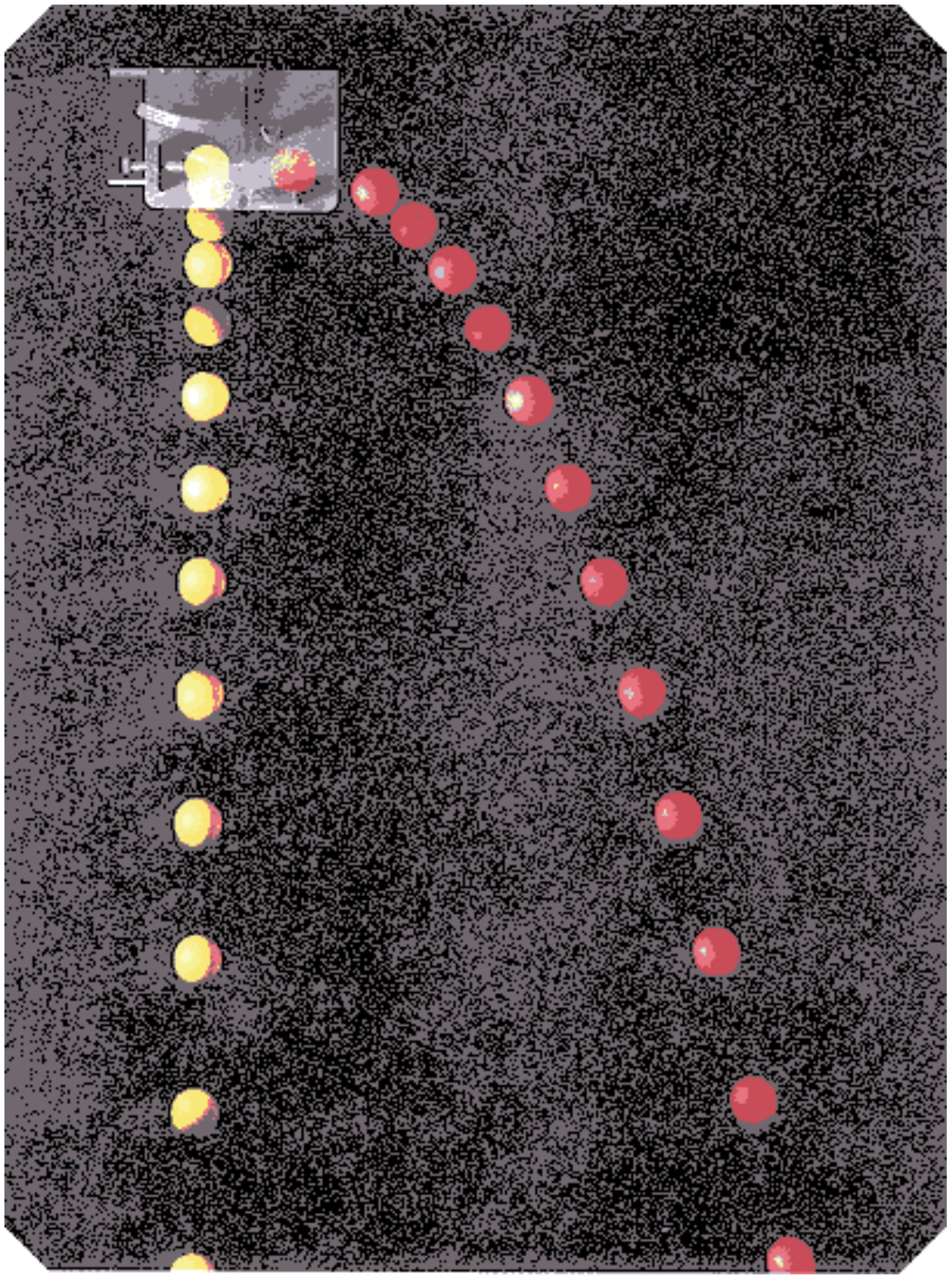

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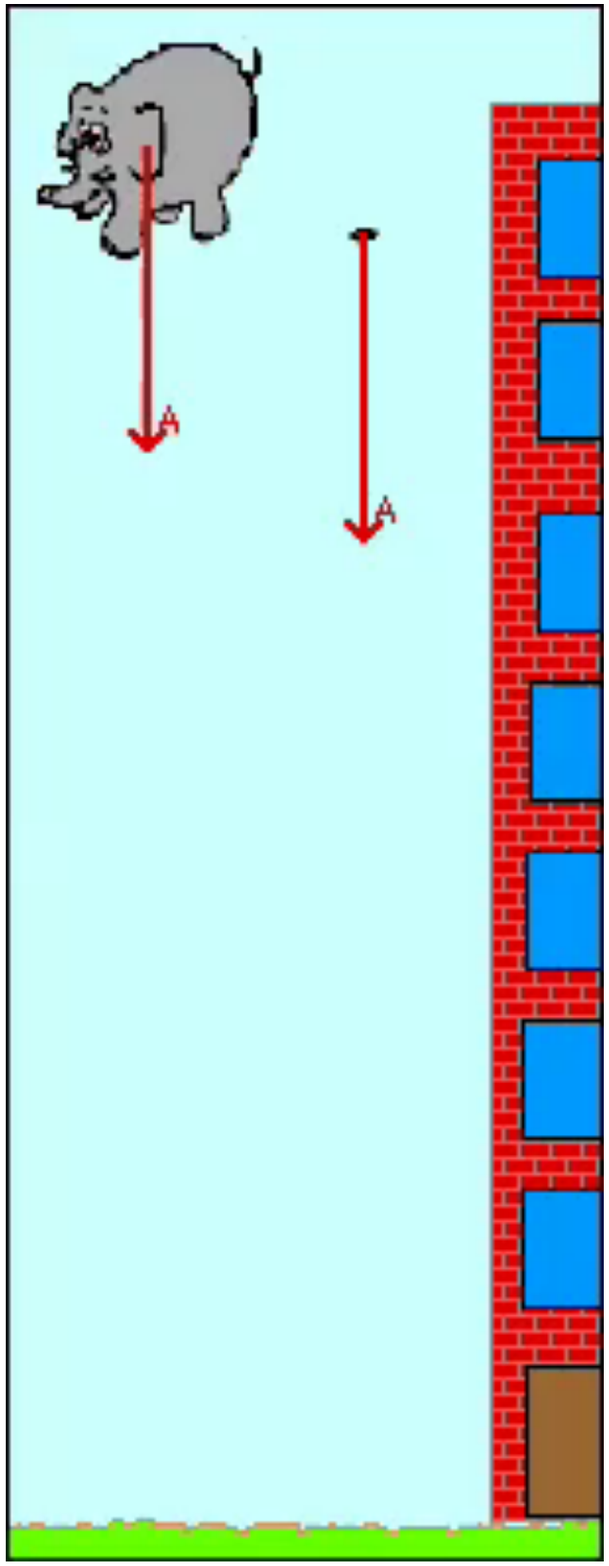
Newton’s Second Law



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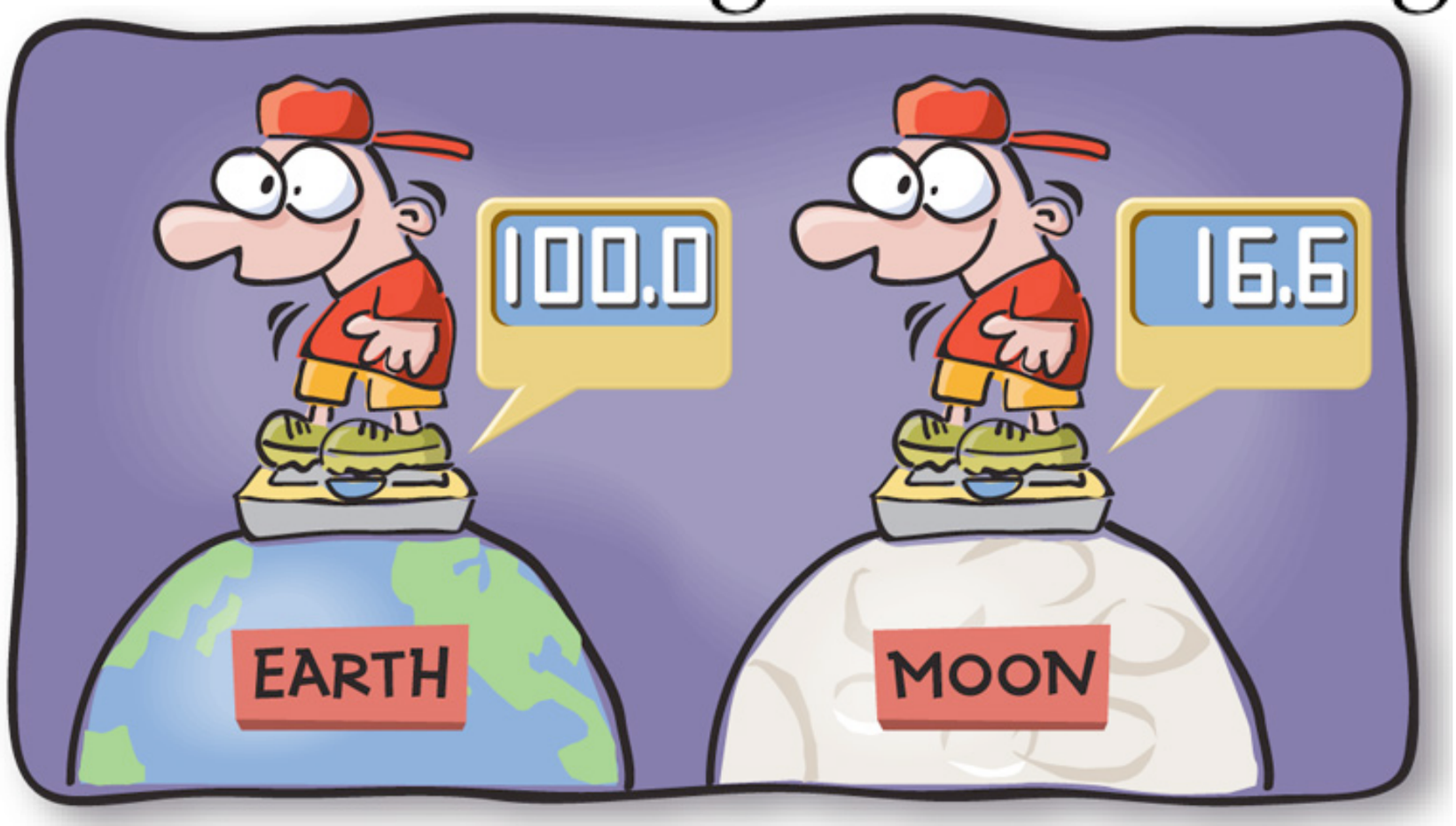
- Sitting on the skateboard push on the wall
  - How does the direction of your push compare to the direction you travel in?
- Sitting on the skateboards, push against another group member that is on a second skateboard.
  - Who goes faster? Why?
  - Try it again and have the other group member push, who goes faster? Why?

Weight

B. <u>Weight</u>- gravitational force exerted on an object

1. Weight results from a force; <u>mass</u> is how much matter an object contains

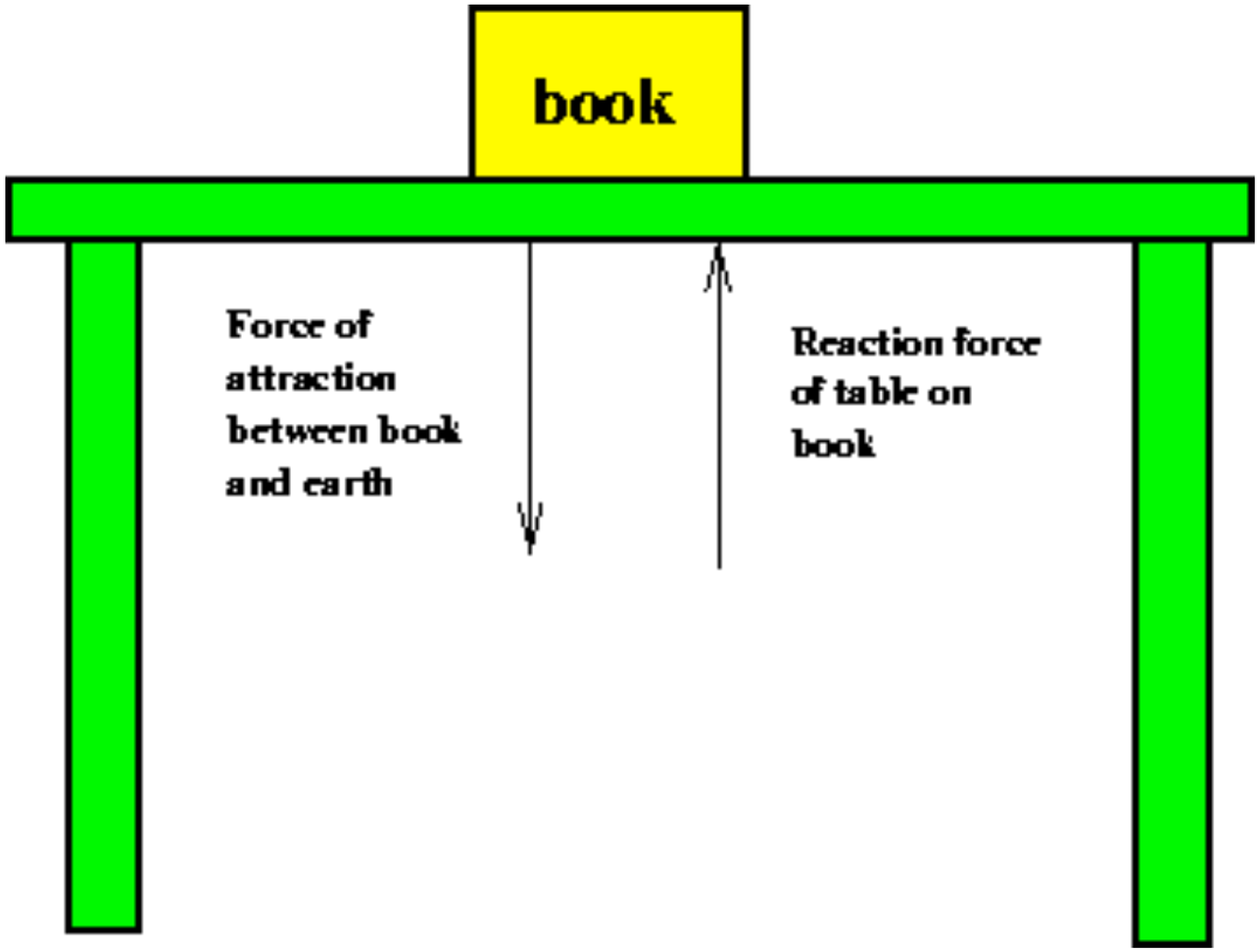
$$W = F_g = ma_g$$

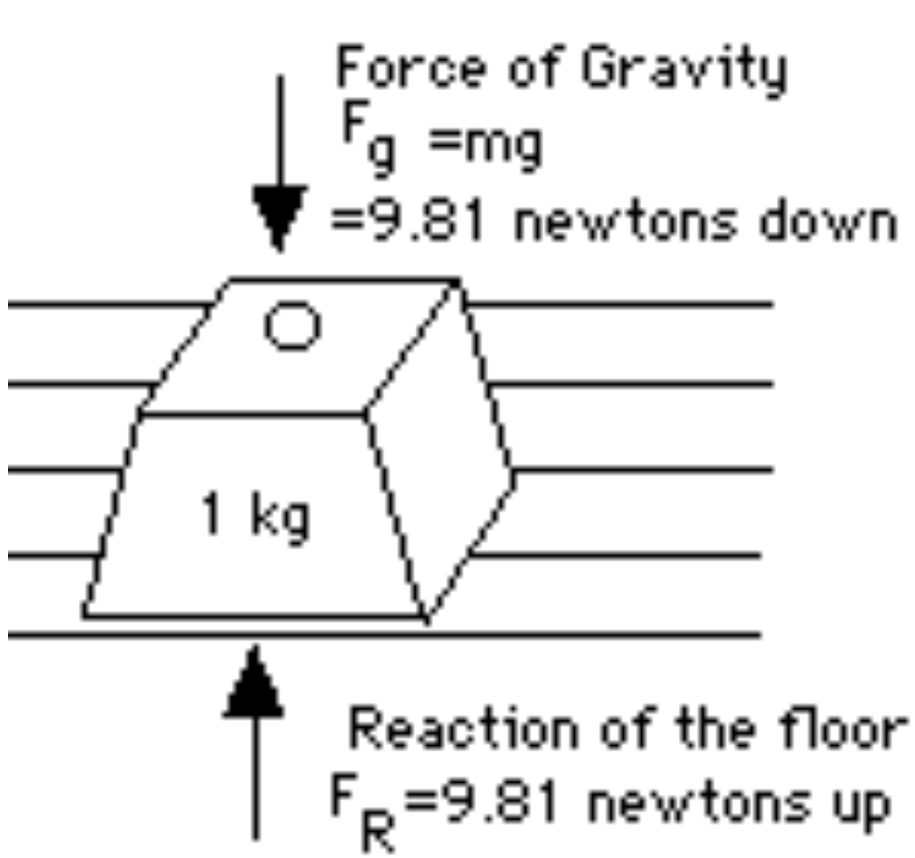


VI. Newton's third law of motion

A. When 1 object exerts a force on a 2nd object, the 2nd object exerts a force that is equal in size and opposite in direction to the force from the 1st object.

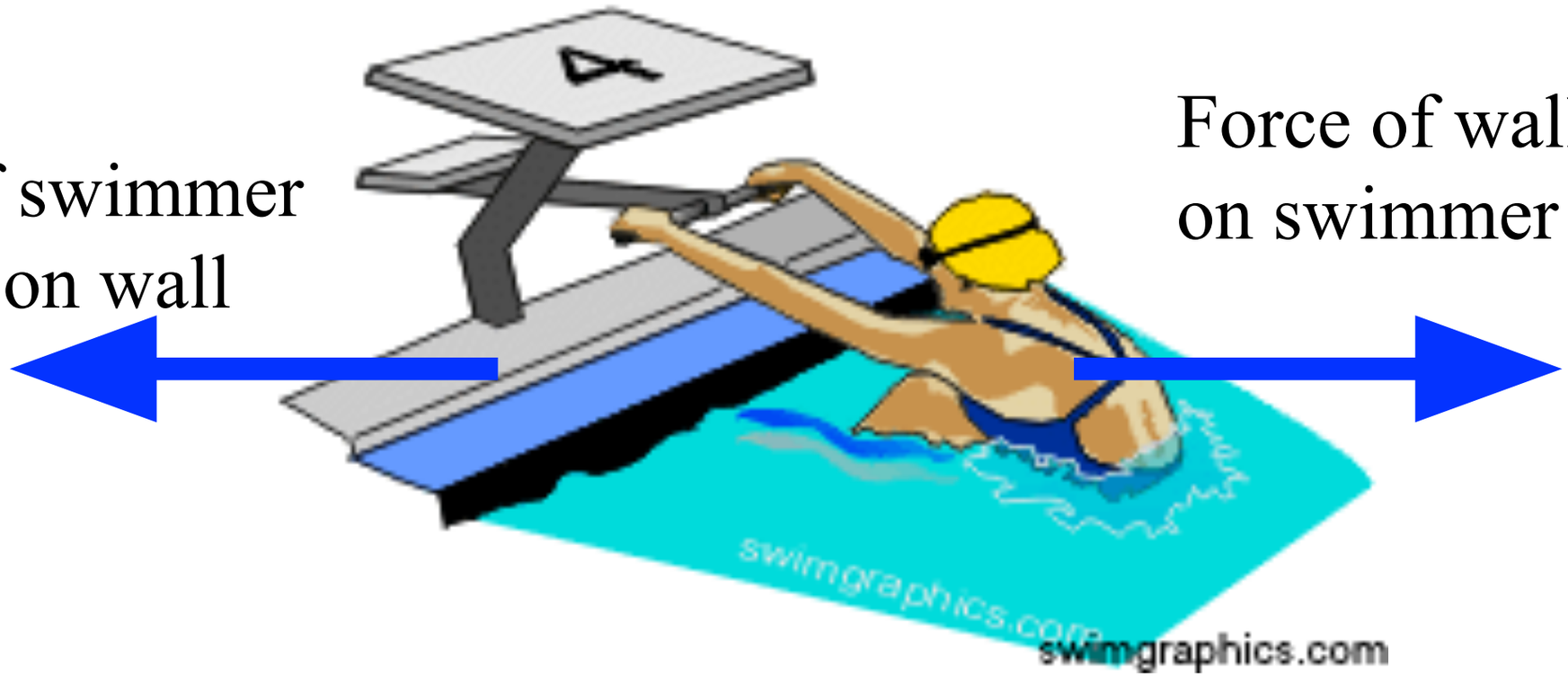
1. For every action, there is an equal & opposite reaction





- **Swimming- swimmer exerts force on wall; wall exerts force on swimmer**
  - **Action-reaction pairs act on different objects**

Force of swimmer pushing on wall



Force of wall pushing on swimmer

Forces act on different objects!

- Forces are equal but accelerations are different because mass are different
  - swimmer: lighter mass -> higher acceleration
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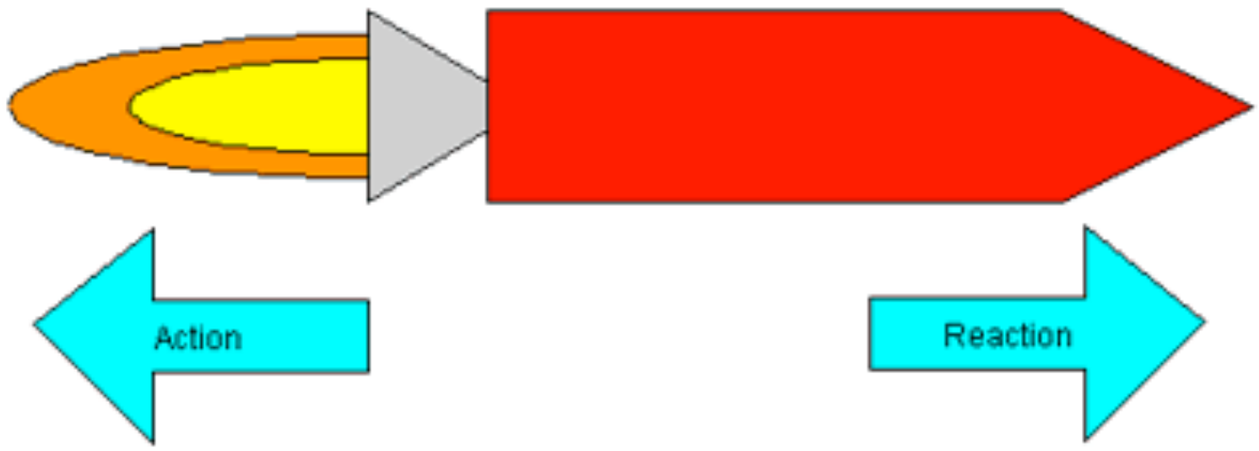
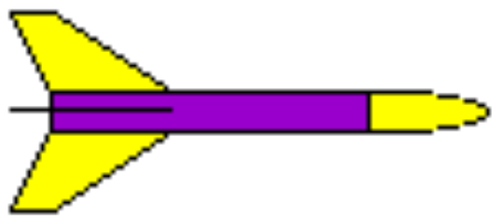
Forces act on different objects!

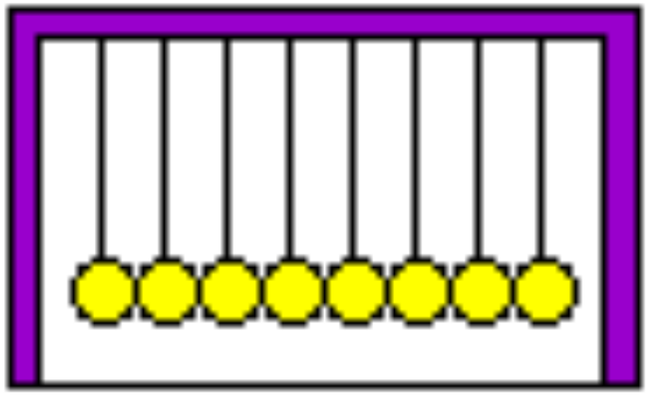
Let's study how a rocket works to understand Newton's Third Law.

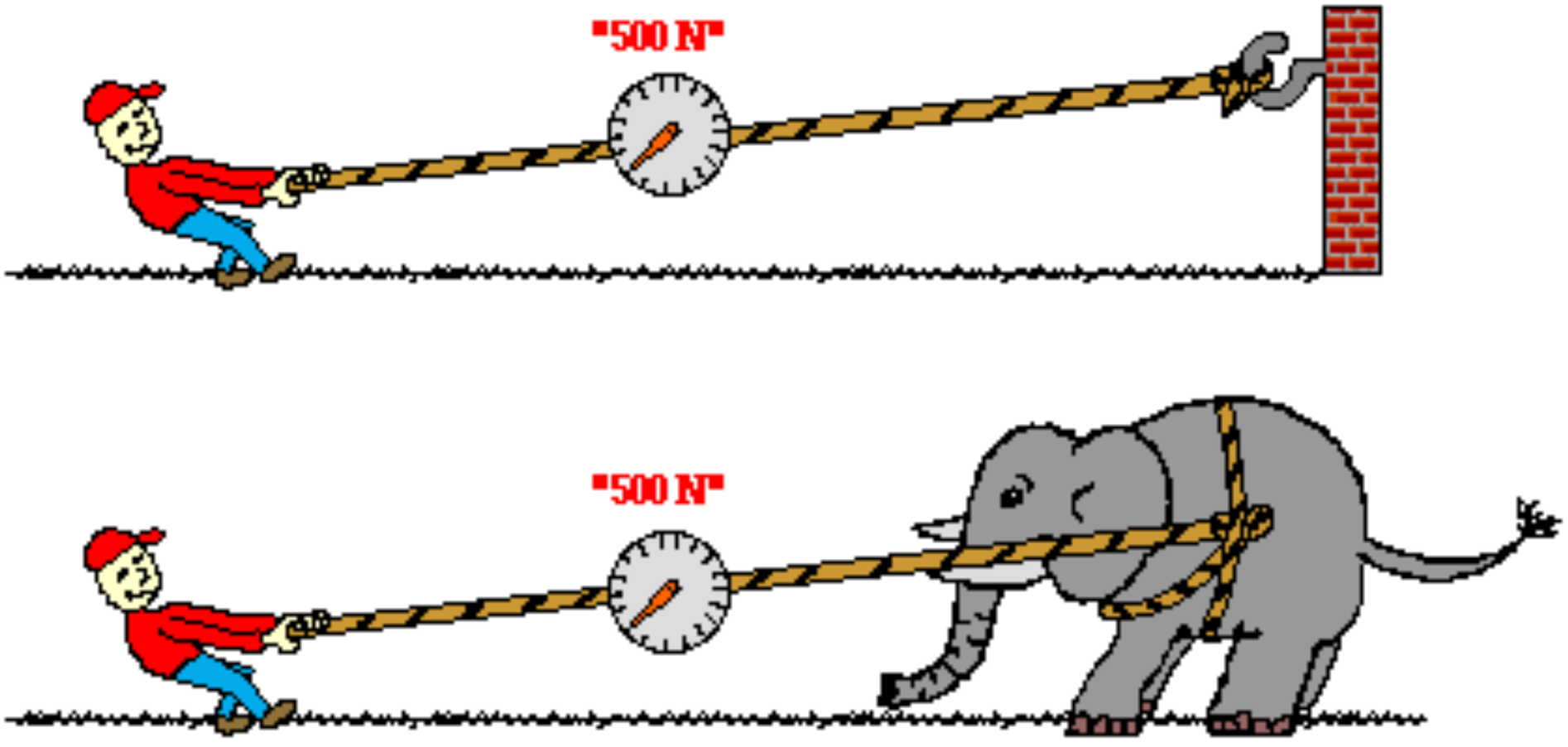


The rocket's **action** is to push down on the ground with the force of its powerful engines, and the **reaction** is that the ground pushes the rocket upwards with an equal force.



Identify the Action & Reaction Pairs





In the top picture, Mike is pulling upon a rope which is attached to a wall. In the bottom picture, the Mike is pulling upon a rope which is attached to an elephant. In each case, the force scale reads 500 Newtons. Mike is pulling …

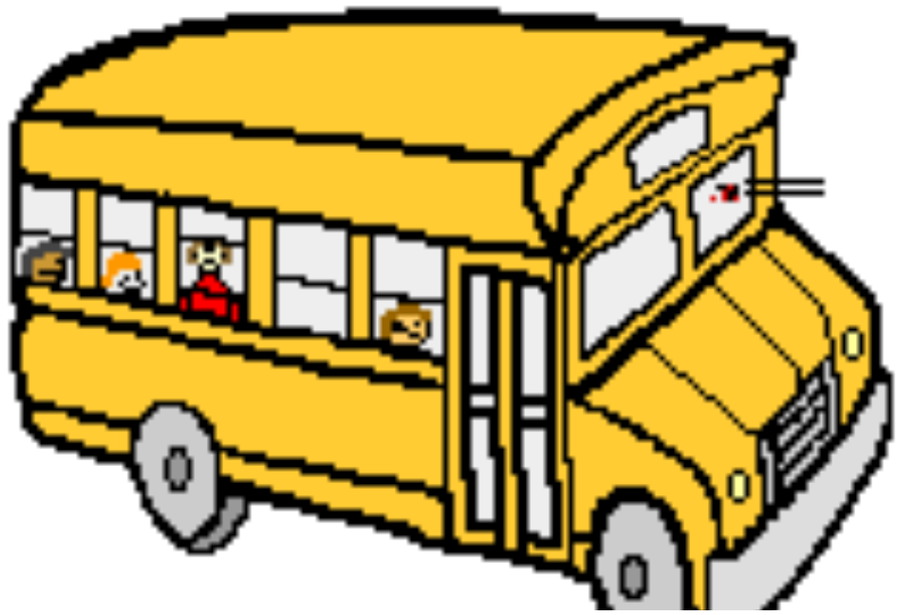
a. with more force when the rope is attached to the wall.

b. with more force when the rope is attached to the elephant.

c. the same force in each case.

While driving down the road, a bug strikes the windshield of a bus and makes a quite obvious mess in front of the face of the driver. This is a clear case of Newton's third law of motion. The bug hit the bus and the bus hits the bug. Which of the two forces is greater: the force on the bug or the force on the bus?

THINK ?



Friction is needed in order to walk. Looking at the action and reaction forces of walking what is the net force on the foot?

How does your inertia cause your body to move compared to a net force acting on it?

A. Same Direction

B. Perpendicular

C. Opposite Direction

D. Depends on the size of the force

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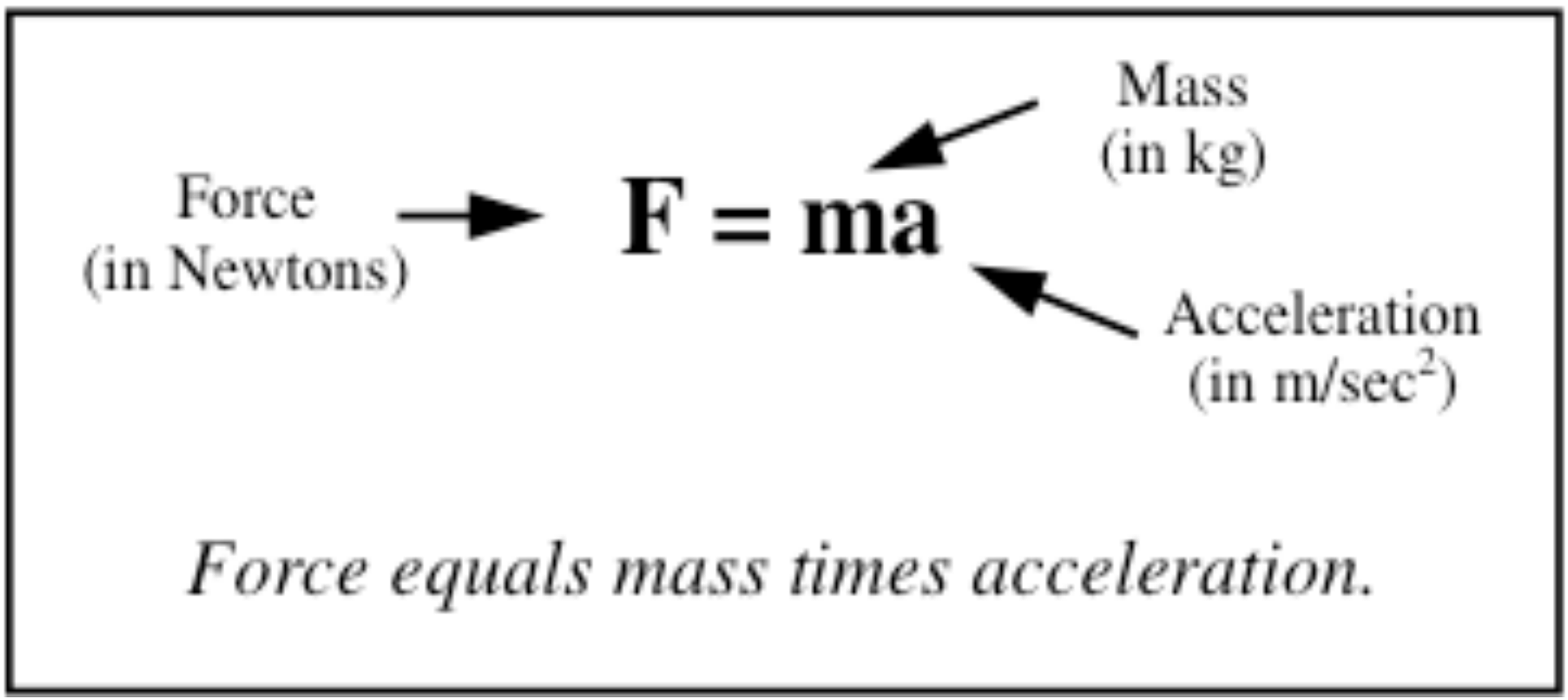

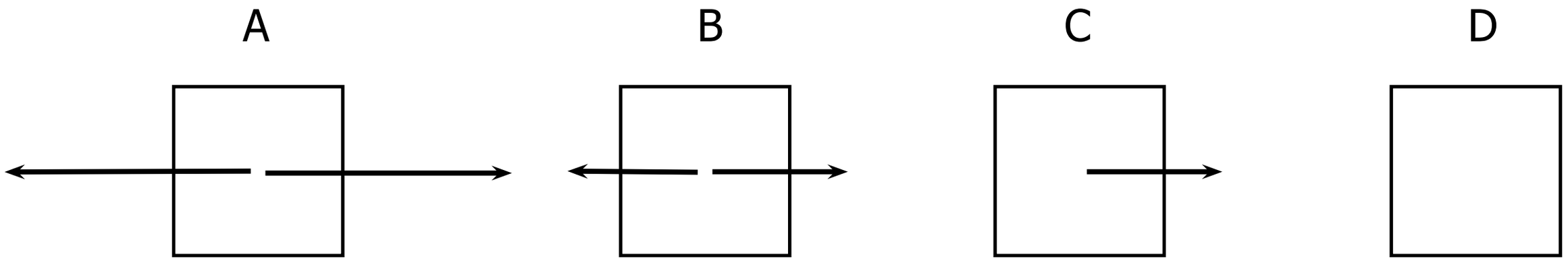

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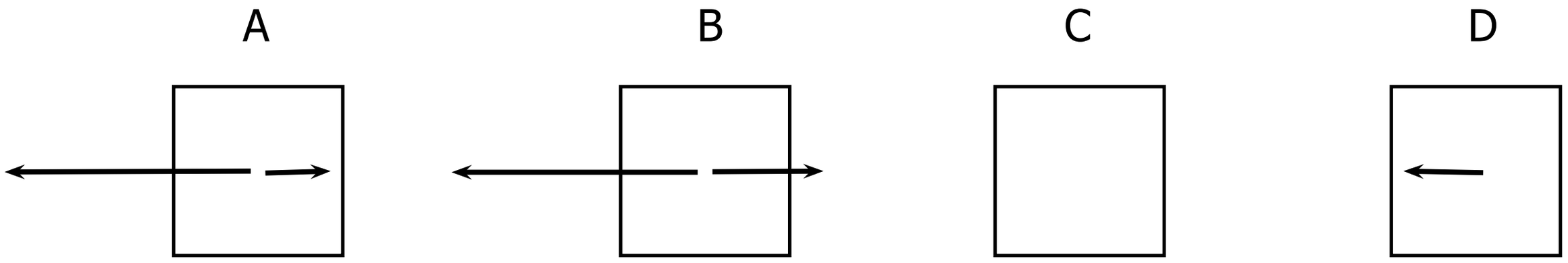

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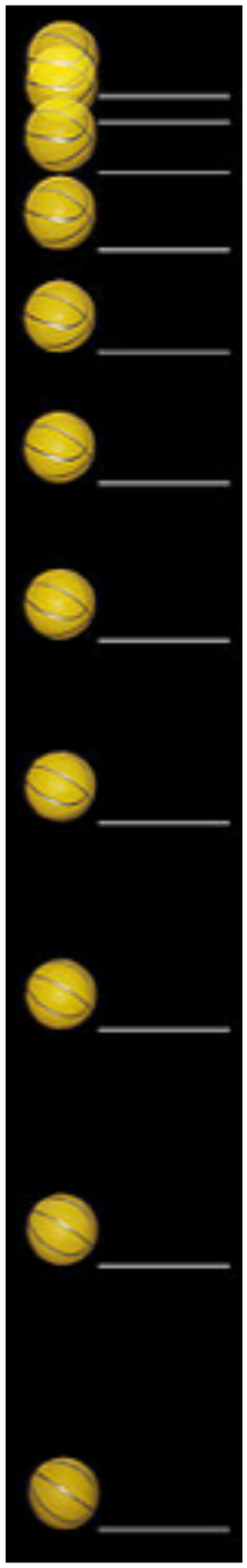

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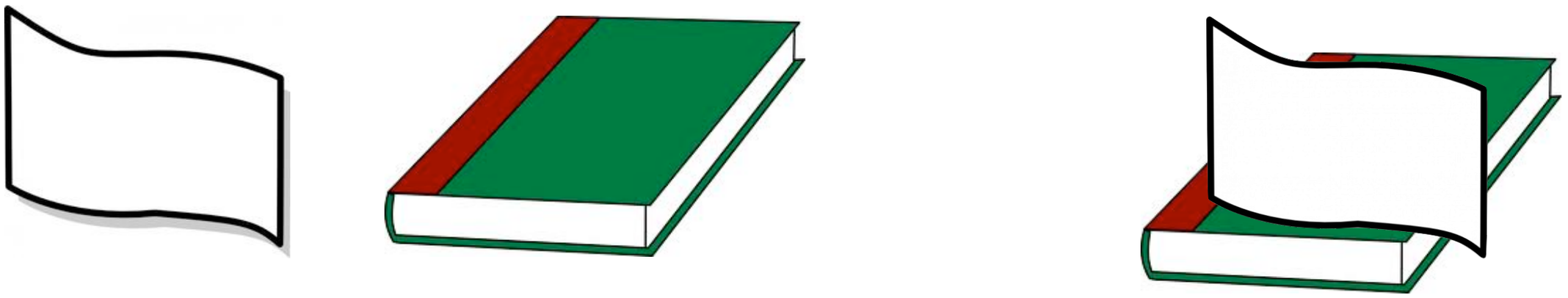

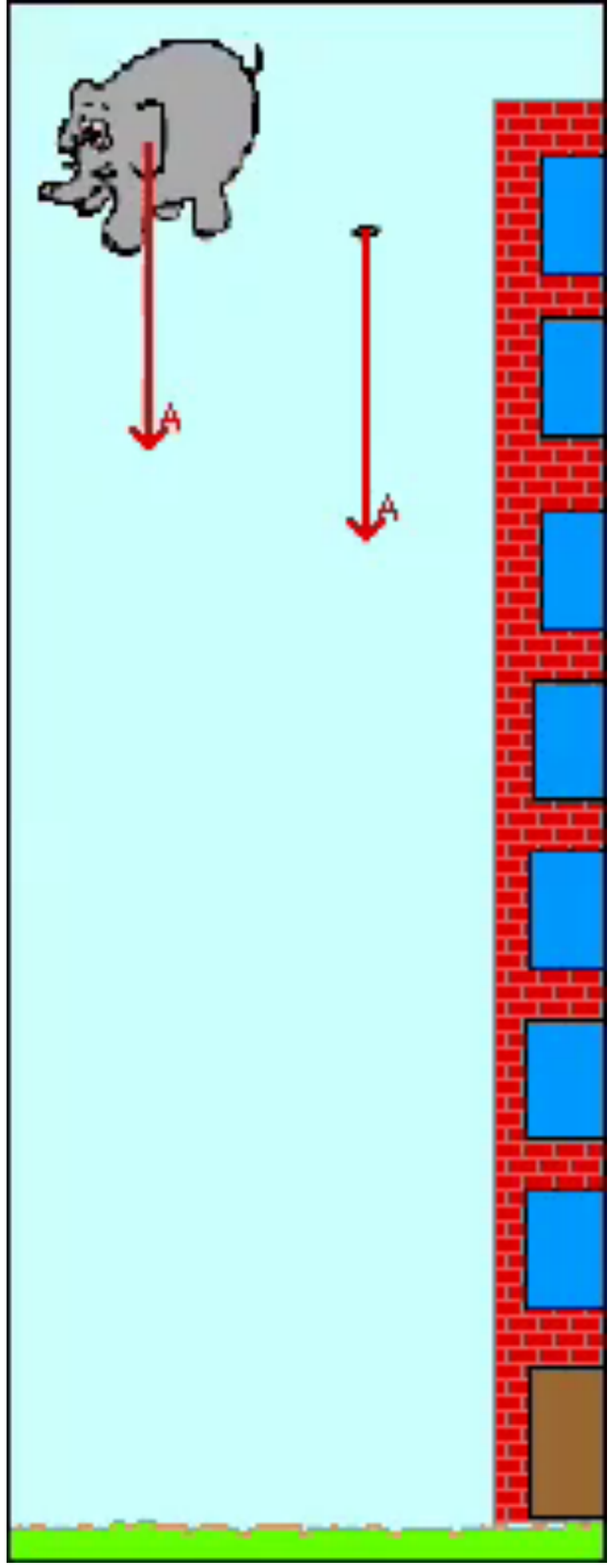

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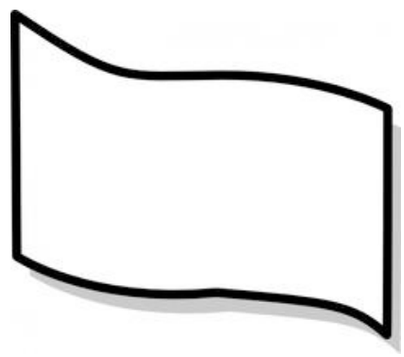

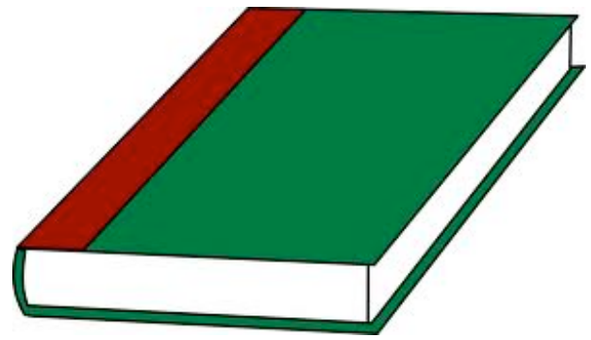

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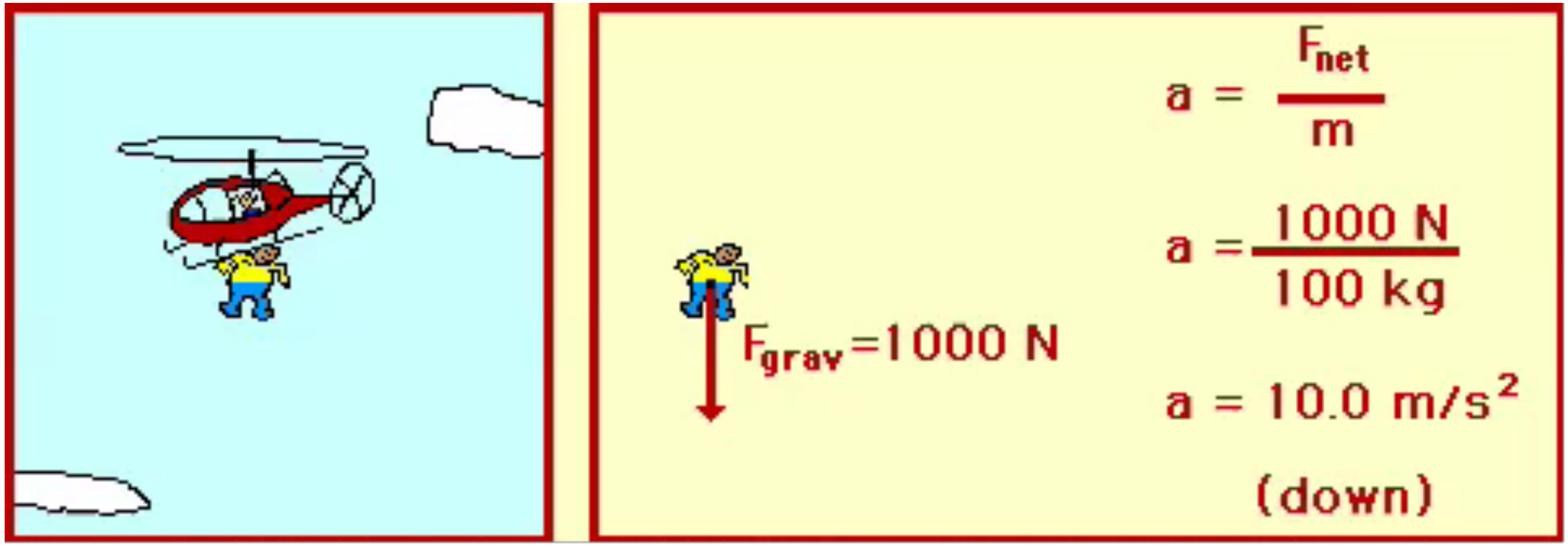

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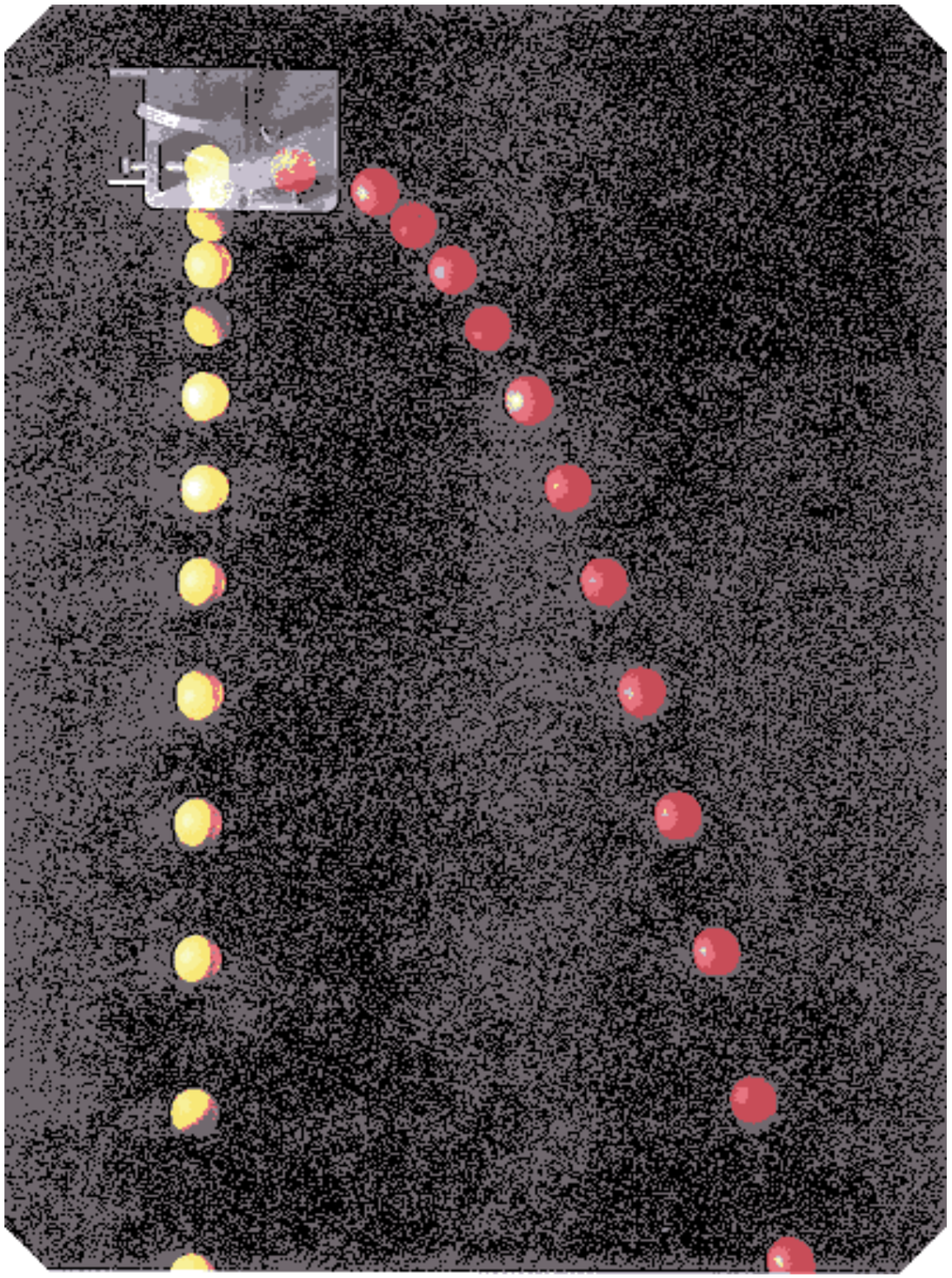

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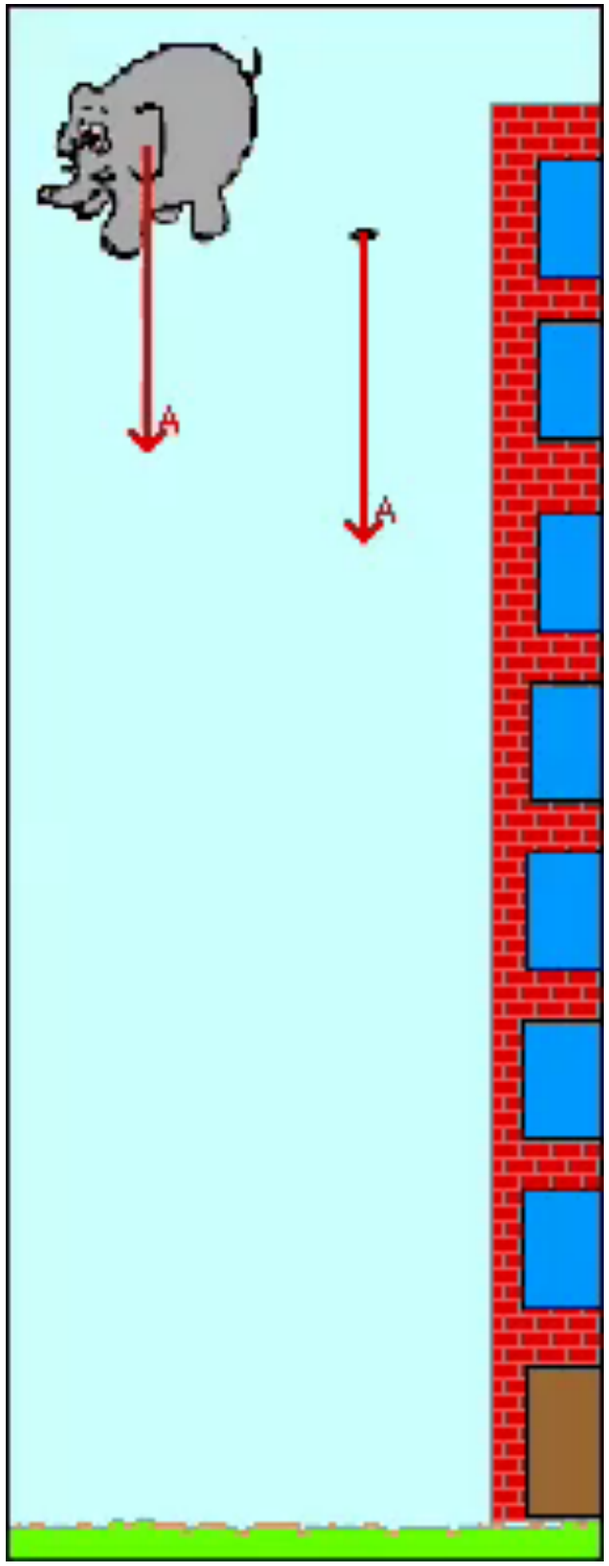

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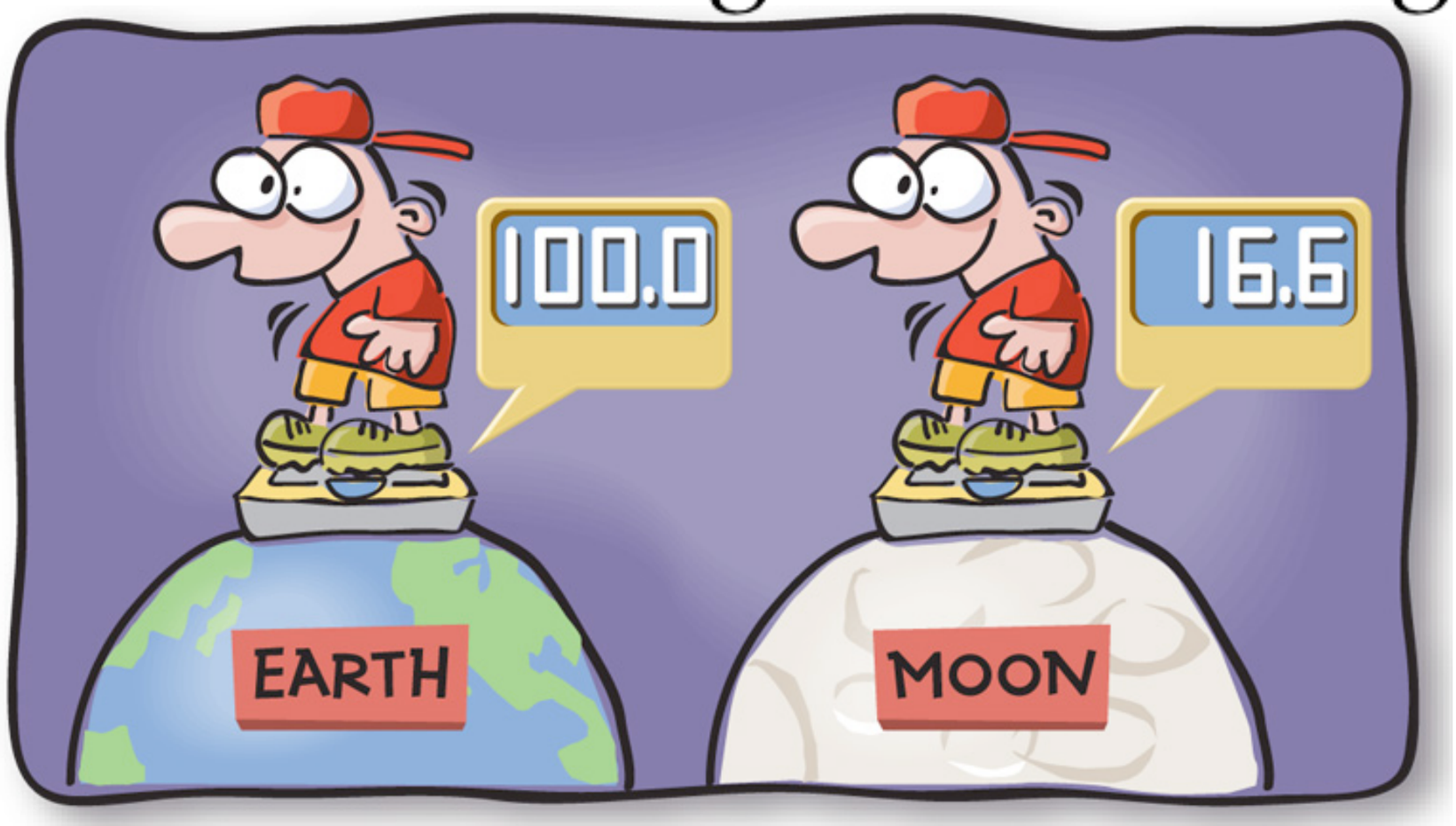

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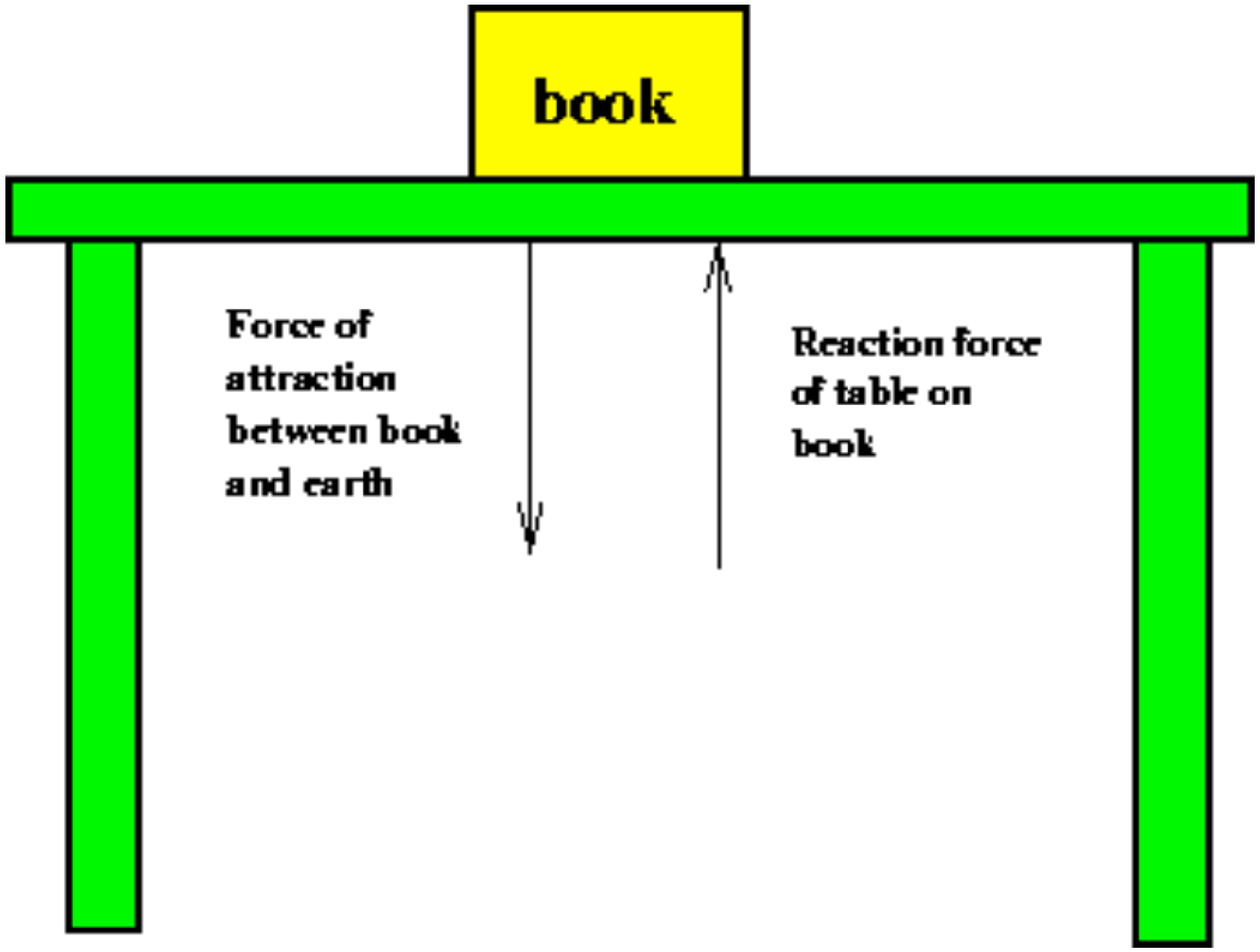

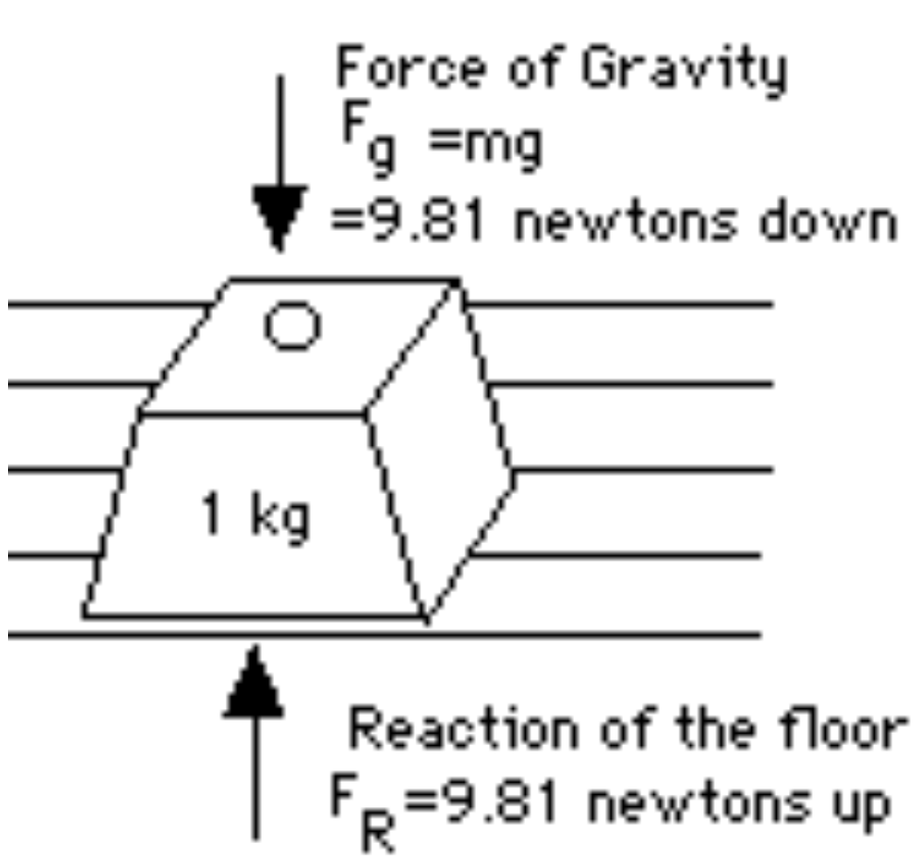

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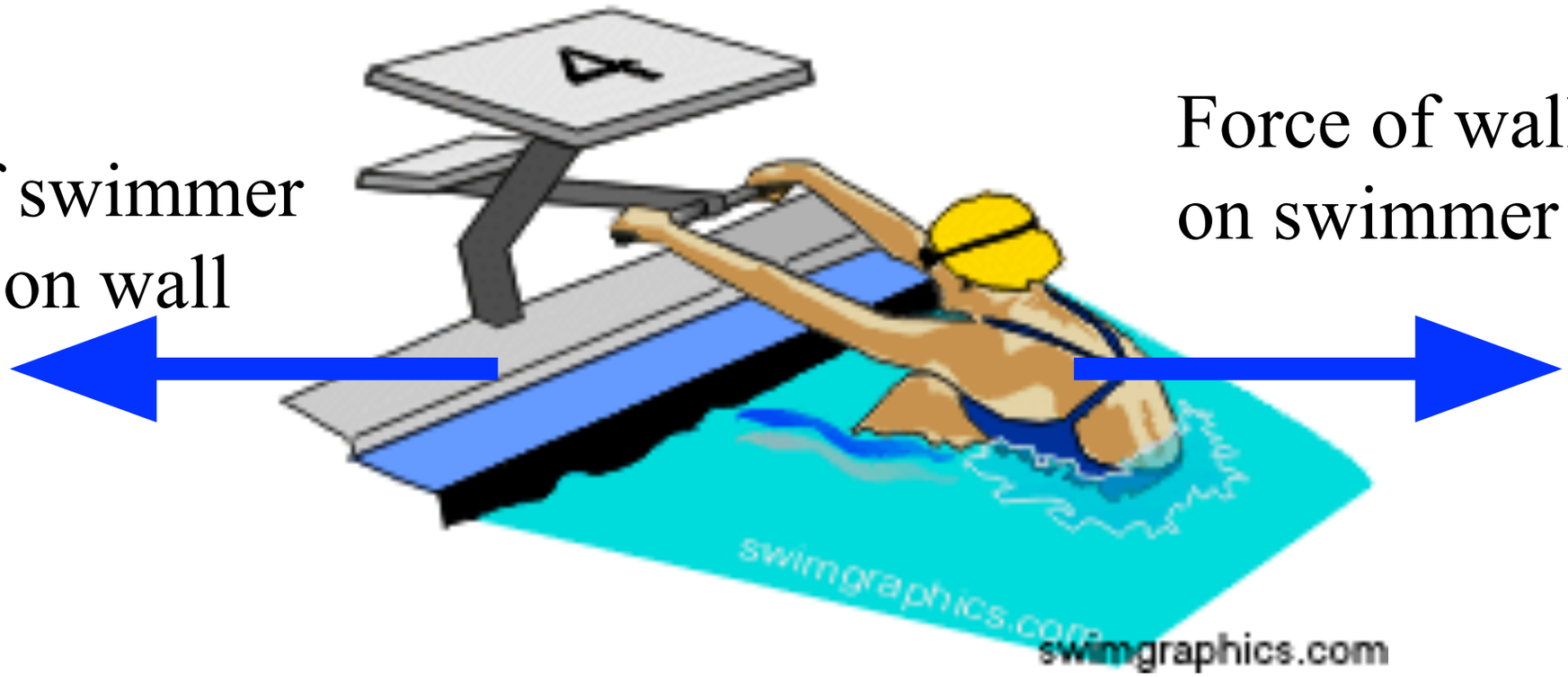

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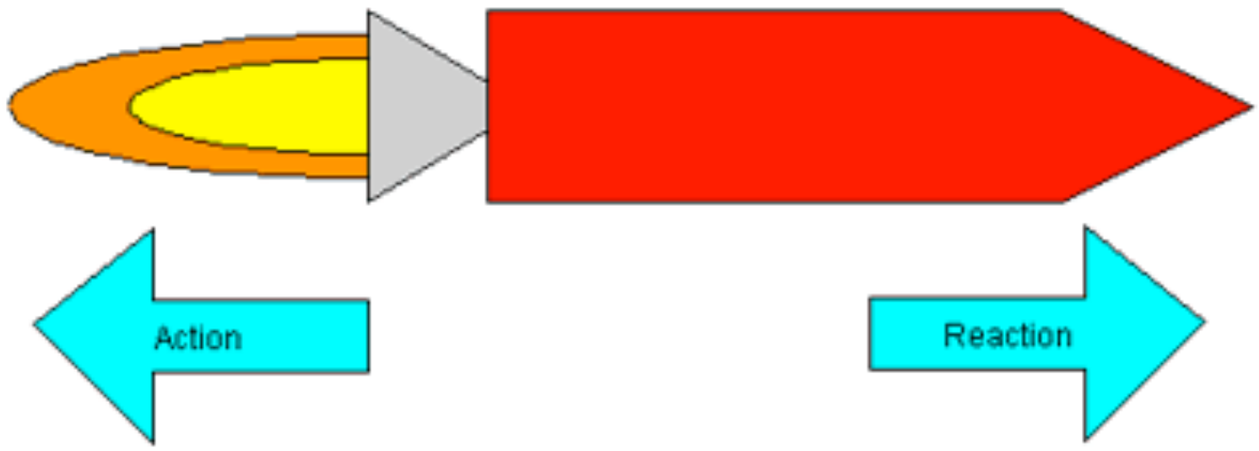
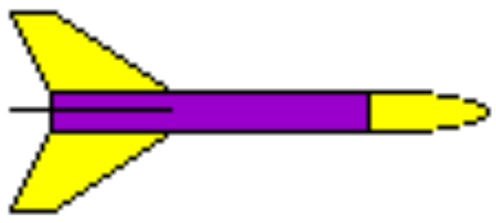
Forces act on different objects!

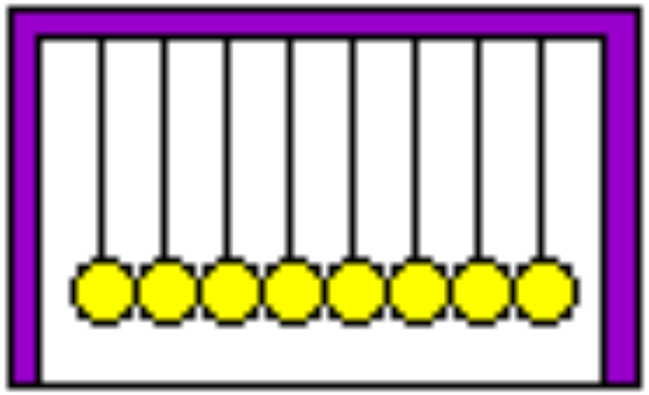
Let's study how a rocket works to understand Newton's Third Law.

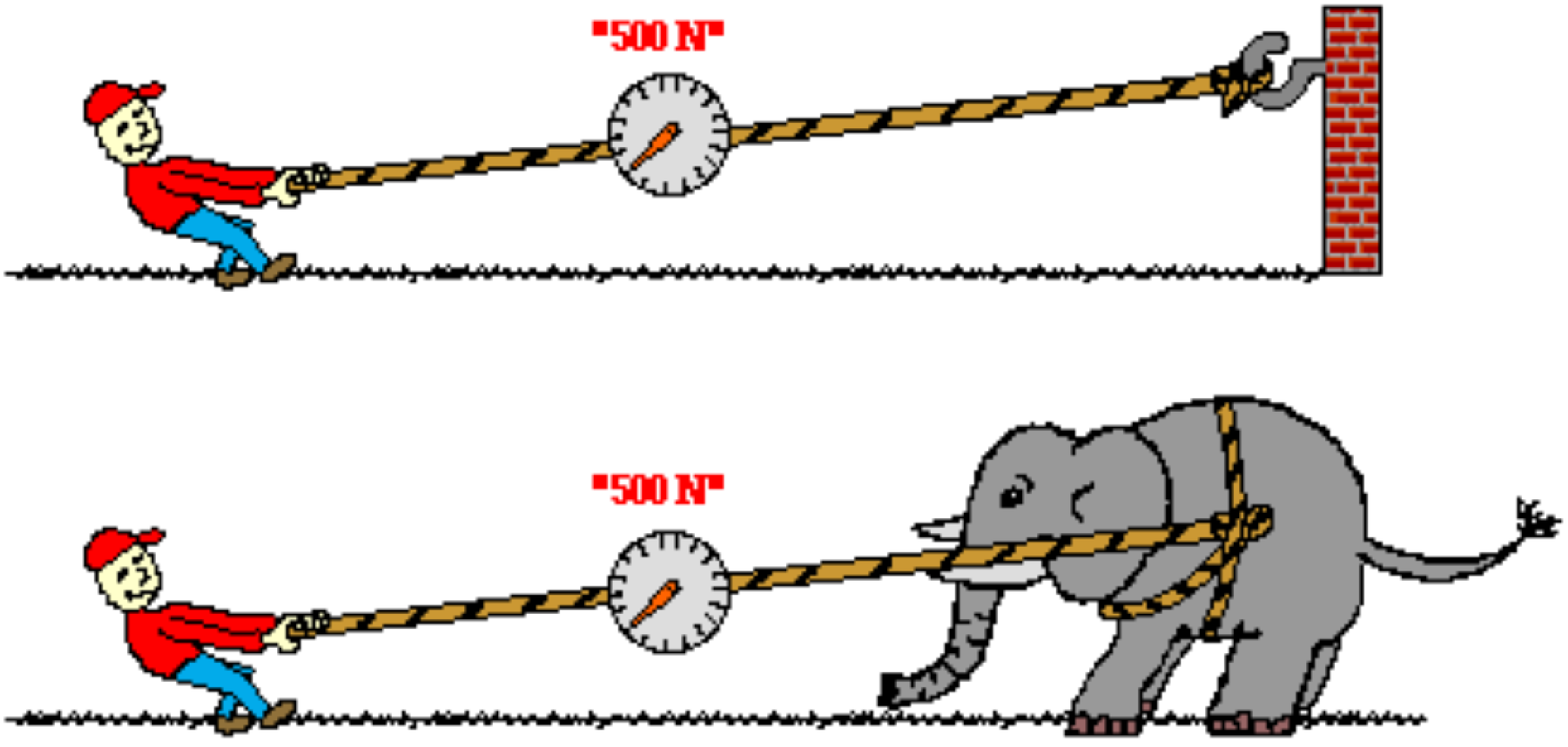


The rocket's **action** is to push down on the ground with the force of its powerful engines, and the **reaction** is that the ground pushes the rocket upwards with an equal force.



Identify the Action & Reaction Pairs





In the top picture, Mike is pulling upon a rope which is attached to a wall. In the bottom picture, the Mike is pulling upon a rope which is attached to an elephant. In each case, the force scale reads 500 Newtons. Mike is pulling …

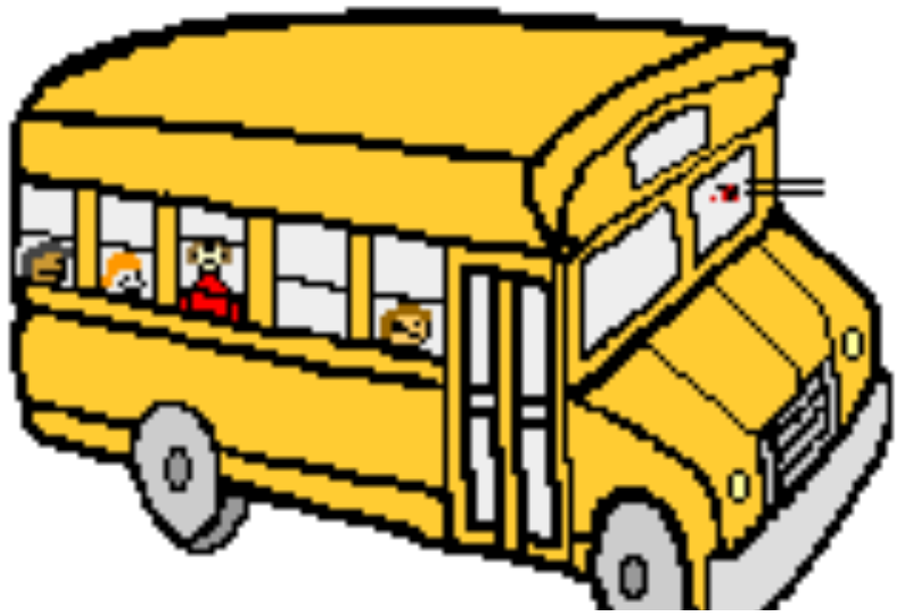
a. with more force when the rope is attached to the wall.

b. with more force when the rope is attached to the elephant.

c. the same force in each case.

While driving down the road, a bug strikes the windshield of a bus and makes a quite obvious mess in front of the face of the driver. This is a clear case of Newton's third law of motion. The bug hit the bus and the bus hits the bug. Which of the two forces is greater: the force on the bug or the force on the bus?

THINK ?



Friction is needed in order to walk. Looking at the action and reaction forces of walking what is the net force on the foot?

How does your inertia cause your body to move compared to a net force acting on it?

A. Same Direction

B. Perpendicular

C. Opposite Direction

D. Depends on the size of the force